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Effects induced by periodontal disease on overall quality of life and self-esteem

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Abstract

Background and aims: Based on the evidence regarding the relationship between inflammatory processes and stress responses, the present study investigated the association between psychological stress and oral health-related quality of life (OHRQoL) measures related to periodontal disease in adult patients.

Methods: OHRQoL measured by the Oral Health Impact Profile 49 (OHIP-49), self-esteem measured by the Rosenberg Self-Esteem Scale (RSES), NA measured by the Eysenck Personality Inventory Questionnaire (EPI-Q), global oral rating of oral comfort and controlling variables (gender, age, number of teeth, experience of periodontitis, location of missing teeth and zone of missing teeth) were collected from 65 patients with periodontitis.

Results: Bivariate analyses showed that the EPI-Q score had the highest correlation with OHIP-49 score ($p<0.05$). Both EPI-Q and RSES scores had a stronger correlation with psychosocial items than physical/functional items of the OHIP-49. In the multivariate analyses, the controlling variables alone explained the variance in the OHIP-49 score, while the addition of EPI-Q score, RSES score, and EPI-Q and RSES score was also explained.

Conclusions: NA had the strongest and most clinically meaningful influence, but both NA and self-esteem was found to influence OHRQoL; low self-esteem and high NA was associated with worse OHRQoL. This indicates the possibility of explaining some of tooth loss impacts on OHRQoL based on personality traits. Psychological stress has a pivotal role in worsening OHRQoL in periodontitis patients.

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1. Introduction

Periodontal diseases are a major oral health problem, as they are still the main reason for tooth loss in industrialized countries. It has been shown that the rate of tooth loss can be decreased by new forms of therapy and prophylactic dental measures. At the same time, the increase in periodontal diseases has become an important issue (Aarabi et al., 2018; AlQallaf et al., 2018; Aoyama et al., 2019; Polizzi et al., 2020a; Santonocito et al., 2020).

The term 'quality of life' is an important factor, which brings the patient and their view into the heart of consideration. 'Quality of life' is a multidimensional construct with no final definition. The World Health Organisation (WHO) describe the quality of life as follows: 'Quality of life is defined as an individual's perception of their position in life in the context of the culture and value systems in which they live and relate to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationship, and relationship to salient features of their environment (Aarabi et al., 2018; Arweiler et al., 2018, 2020; Badersten et al., 1984; Batool et al., 2018; Merlo et al., 2021; Polizzi et al., 2020b; Santonocito et al., 2021a, 2021b). In these terms, clinical psychological factors affecting biological functioning and producing maladjustment has gained attention (Barchetta et al., 2022; Burke et al., 2015; Cal et al., 2015; Caputo et al., 2022; Di Giuseppe et al., 2022; Frisone et al., 2021; Martino et al., 2021; Myles & Merlo, 2021; Popoviciu et al., 2022; Schneiderman et al., 2001; Vicario et al., 2022; Vita et al., 2020). During the last few decades, a number of measures have been introduced to measure and describe the oral health-related quality of life (OHRQoL). Interpretation of these measures must be carried out not only with regard to the psychometric properties (e.g., validity and reliability), but contextual factors must also be included in the interpretation. Factors such as age, gender, dental status variables, socio-economic status, self-reported oral health, dental attendance, and personality traits might influence patients' assessment. Understanding the influence of personality traits is necessary if clinical investigations using OHRQoL measures are to be meaningfully interpreted (Aarabi et al., 2018; Chapple et al., 2012; Chen et al., 2009, 2012; Chen & Olsen, 2019; Cosgarea et al., 2019; Culshaw et al., 2011).

Moreover, a review of published articles shows a strong positive relationship between periodontal diseases and psychological factors such as stress, distress, orthodontic treatment (d'Apuzzo, 2021; De Felice et al., 2020; Marra P, 2020), anxiety, depression and loneliness.

In response to psychological or certain physiological stressors, an inflammatory reaction occurs by releasing neuropeptides and inflammatory mediators from the sensory nerves and activating

mast cells or other inflammatory cells. It has been shown that stress can effectively increase serum IL-1β, IL-6, and IL-10 and decrease IFN-γ production, suggesting that there is an interaction between the endocrine and immune systems in response to physiological stress (Oates et al., 2002; Offenbacher et al., 2016; Oliveira et al., 2009; Pussinen et al., 2007; Queiroz-Junior et al., 2012; Rogler et al., 2017). Furthermore, the patients with mood disorders were also found to have an exaggerated inflammatory response to psychological stress compared to healthy individuals (Ehlers, 2000; Elficki et al., 2017; Furfaro et al., 2017; Gabriela Teixeira et al., 2014; Gaffen & Hajishengallis, 2008; Garlet et al., 2007).

The most common questionnaire for detecting the OHQoL is the Oral Health Impact Profile (OHIP). This has been developed in Australia by Slade & Spencer and included 49 questions. The OHIP was translated into German (OHIP-G) by John et al. (John et al., 2002) also developed three short versions (with 5, 14 and 21 questions). The OHIP has been used in many countries, for example, in England, where toothless patients were restored with implant-stabilized or conventional complete dentures and were questioned about their OHQoL before and after treatment (Al Hamad et al., 2019; El Sayed et al., 2019; Ferreira et al., 2017; Gazit-Rappaport et al., 2010; Hughes & Herrick, 2017; Isiekwe et al., 2016).

It was hypothesized that low self-esteem and high NA would be associated with worse OHRQoL, thereby indicating that the personality traits could explain some of the impacts of periodontitis and tooth loss. Based on these findings, the aim of this study was to investigate the influence of negative affectivity and self-esteem on OHRQoL in patients with periodontitis.

2. Materials and Methods

For the present study, 65 patients with periodontitis were recruited at the School of Dentistry at the University of Catania, Italy. The patients were included consecutively, and the treating student and the clinical instructor collected the questionnaires from the patient before any treatment was performed. Before periodontal or dental treatment, the patients were motivated and instructed in better oral and prosthetic hygiene. Patients were excluded if presented with acute pain, profound caries lesions, instruction and light cleaning and/or need for temporomandibular joint treatment. The participants should further read and answer the questionnaires, have a history taking obtained, and an oral examination performed.

2.1 Protocol

For the study, a European version of the OHIP-49 was chosen. The OHIP-49 consisted of 49 questions related to problems in the oral region (10). The participants answered how often each

problem had occurred during the past month on a scale with six choices and according scores: very often (4), fairly often (3), occasionally (2), hardly ever (1), never (0) or don't know. To calculate an overall OHIP-49 score for each patient, the scores from the 49 answers were added, thereby giving a score between 0 and 196.

Higher negative affectivity and lower self-esteem could be hypothesized to be more strongly correlated to psychosocial than physical aspects of OHRQoL. To investigate this, two major domains were generated from the originally seven domains of the OHIP-49: a physical domain including the domains functional limitation, physical pain and physical disability (item 1–18 and 24–32) and a psychosocial domain including the domains psychological discomfort, psychological disability, social disability and handicap (item 19–23 and 33–49).

Moreover, the Rosenberg Self-Esteem Scale (RSES) (Chao et al., 2017), consisting of 10 items, was used to analyze self-esteem. Each item was rated on a 4-point response scale, 1 being 'strongly agree' and 4 'strongly disagree'. Five items were positively worded (item 1, 3, 4, 7, 10), and 5 were negatively worded (item 2, 5, 6, 8, 9). The scores for the positively worded items were in the analysis inversed so that a score of 1 ('strongly agree') was set to 4. Addition of the item scores gave an overall score from 10-40 with a higher score indicating higher self-esteem. Furthermore, Eysenck personality inventory questionnaire Negative Affectivity (NA) was measured by the Eysenck Personality Inventory Questionnaire (EPIQ) (Riihimaki et al., 2016), which consisted of nine questions regarding affection with dichotomous answers (yes/no). A point was given each time a question was answered 'yes' giving a score for each participant between 0 and 9 and a higher score indicating higher NA. To investigate the influence of NA and selfesteem on OHRQoL, the current oral comfort was rated on a 5-point response scale from 1 = 'very poor' to 5 = 'very good'. For analytic purposes, the ratings were divided in groups (i) good oral comfort (score 4 and 5), (ii) ok oral comfort (score 3) and (iii) poor oral comfort (score 1 and 2).

2.2 Statistical analysis

Descriptive statistics was used to calculate the distribution of participants according to controlling variables and the distribution of the OHIP-49, EPIQ and RSES scores. Bivariate analyses of the influence of age, number of teeth, RSES score and EPI-Q score on OHIP-49 score were performed using Pearson's correlation. The influence of gender, the experience of periodontitis, location of missing teeth and zone of missing teeth was calculated using Student's t-tests. Pearson's correlation was also used to test the correlation between EPI-Q score and

RSES score and if the EPI-Q and RSES score had a higher correlation with the psychosocial items than with the physical items of the OHIP-49.

As self-esteem and negative affectivity were seen as mediators of OHRQoL in the patient group, the amount of variance in OHIP-49 score explained by the EPI-Q score and RSES score was calculated. This was carried out using general linear models to create four multivariate models from which the R-squared value was used: the first model included the controlling variables only, EPI-Q score was added in the second model, RSES score in the third model, and both EPI-Q and RSES score were added in the fourth and final model. Age, number of teeth, EPI-Q score and RSES score were considered continuous variables, and gender, experience of periodontitis, location and zone of missing teeth as class variables. Interaction between the variables where also tested in the models. No interaction was found between any of the variables. SPSS 17.0 software was used to analyze all data. A p value smaller than 0.05 was set as statistically significant.

3. Results

The distribution of the OHIP-49, EPI-Q and RSES scores and the distribution of the participants according to age, number of teeth, gender, experience of RDP, and location and zone of missing teeth are presented in Table 1.

Table 1. Distribution of EPI-Q, RSES and OHIP-49 scores in analyzed patients

Distribution	Values
OHIP-49 score (mean)	48.6 (5-106)
EPI-Q score (mean)	2.9 (0-8)
RSES score (mean)	31.3 (15-51)
Age (mean)	61.2 (35-69)
Number of teeth (mean)	14.36 (4-23)
Gender	
Women	32
Man	33
Experience with periodontitis	
Yes	42
No	23
Tooth loss location	
Maxillary/mandible	51
Both	14
Zone of tooth loss	
Maxillary/mandible	31
Both	34

Table 2 summarizes the bivariate analyses of the influence of the explaining variables on OHIP-49 score. Higher age and higher self-esteem had a weak but significant correlation to lower OHIP-49 score. A lower EPI-Q score had a significant and acceptable correlation to lower

OHIP-49 score. The EPI-Q score had a stronger correlation with the psychosocial domain (R = 0.51, P < 0.01) than the physical (R = 0.42, P < 0.01) domain. The RSES score also had a stronger correlation with the psychosocial domain (R = -0.34, P < 0.01) than the physical (R = -0.26, P = 0.01) domain. A weak but significant correlation (R = -0.33, P < 0.01) was found between the EPI-Q and RSES score.

Table 2. Bivariate relationships between OHIP-49 score and all explanatory variables

Variable	***R*** **value**
Age	-0.33
Number of teeth	0.06
RSES score	-0.34
EPI-Q score	0.51
Gender	
Women	55.23 (4.49)
Man	43.32 (4.89)
Experience with periodontitis	
Yes	48.66 (4.23)
No	51.33 (5.26)
Tooth loss location	
Maxillary/mandible	49.65 (6.65)
Both	51.23 (8.54)
Zone of tooth loss	
Maxillary/mandible	57.69 (6.95)
Both	46.58 (4.32)

The results from the multivariate models created to explain the variance in OHIP-49 score are shown in Table 3.

Table 3. Multivariate models explaining the variance in OHIP-49 score and parameter estimates (SE) from the final model

Explanation percentage of variance in OHIP-49 score	Value
Model 1 – Controlling variables	16.56%
Model 2 – Controlling variables + EPI-Q	28.54%
Model 3 – Controlling variables + RSES	24.33%
Model 4 – Controlling variables + EPI-Q	32.12%
Parameter estimates from model 4	
Age	-0.72 (0.36)
Number of teeth	0.32 (0.71)
RSES Score	-1.15 (0.66)
EPI-Q score	4.99 (1.54)
Gender (man/woman)	5.15 (6.65)
Periodontitis experience (yes/no)	4.85 (7.78)
Tooth loss location (maxillary/mandible or both)	3.78 (8.24)
Zone of tooth loss (anterior/posterior)	3.19 (6.98)

Moreover, the addition of EPI-Q score to the first model explained an additional 12.66%, while the RSES score to the first model explained additional 5.44% of the variance. The addition of both EPI-Q and RSES score to the first model explained additional 14.28% of the variance.

When expressed as a relative increase, addition of EPI-Q score to the first model provided a 65.44% increase in R-square, while addition of RSES score provided a 33.21% increase. Addition of both EPI-Q and RSES score provided a 78.45% increase in R-square. The parameter estimates from the final model showed that for each unit increase in EPI-Q score, the OHIP-49 score increased by a statistically significant 5.5 units and for each unit increase in RSES score, the OHIP-49 score decreased by a statistically nonsignificant 1.3 units. The number of EPI-Q units needed to reach the MID of 9 OHIP-49 units was therefore 1.71, and the number of RSES units needed was 8.16. The mean EPI-Q score in participants reporting good, ok and poor oral comfort was 1.82, 2.47 and 4.29, respectively, and the mean RSES score 35.33, 33.41 and 32.24, respectively. The difference in EPIQ score between participants reporting poor and good oral comfort, and participants reporting poor and ok oral comfort was statistically significant ($P < 0.01$). The difference in RSES score between participants reporting good and poor oral comfort was also statistically significant ($P < 0.02$). In relation to the differences needed to be determined clinically significant calculated from the parameter estimates, the difference of 2.39 EPI-Q units between participants reporting poor and good oral comfort was clinically significant, the difference of 1.71 EPI-Q units between participants reporting poor and ok oral comfort was borderline significant, whereas the difference in RSES score was clinically nonsignificant.

4. Discussion

Quality of life is an important factor, which brings the subjective feelings of patients into the heart of consideration. The OHQoL describes the patients' subjective experience of oral health and provides information to complement objective clinical parameters such as PPD and PBI. The OHRQoL and other similar have been shown to be reliable and sensitive to changes.

In the present study, low self-esteem and high NA would be associated with worse OHRQoL in the study population consisting of patients with partial tooth loss. The results showed that this was indeed the case. The limited population size was recognized as a limitation of the study. Even though the study population was large enough to produce significant and reliable results, the population was selected from a dental school. Therefore, the results should not be generalized to the entire population. Bias could also exist as it was not registered why potential participants were not included.

Prior studies have shown, however, that the OHIP-49 were able to detect the impact of tooth loss in a similar population as the one in this study. Kressin et al. (Kressin et al., 2001) also found that NA was more strongly correlated with the OHIP-49 than the OHRQoL measures

the Oral Health-Related Quality of Life Measure and the Geriatric Oral Health Assessment Instrument. The controlling variables (i.e. age, gender, number of teeth, experience of RDP, location and zone of missing teeth) were selected as they were thought to potentially influence the OHIP- 49 score in the study population, especially in cases with orthodontic patients (Cozzani et al., 2020a; Cozzani et al., 2020b). The multivariate analyses showed that the controlling variables indeed explained some of the variance in OHIP-49 score and the bivariate analyses showed that the high age span in the study population especially influenced the OHIP-49 score.

Peridontitis, with its burden of bacteria, has been shown to trigger systemic diseases (Dogne et al., 2006; Farrah et al., 2018; Fujisaka et al., 2017; Hajishengallis, 2015; Iqbal et al., 2015; Jamali et al., 2018; Klionsky et al., 2016). It is recognized that the controlling variables in this study does not encompass all OHRQoL aspects and other dental status variables, socioeconomic status and dental attendance could account for additional variance in the OHIP-49 score (Brennan et al., 2006). Further, it was only registered if the participants had experience of wearing an RDP and not if the experience was poor or good. A poor experience of wearing an RDP could translate into poor OHRQoL prior to treatment.

Oral health-related quality of life was significantly influenced by periodontal disease. Several studies have shown that patients with a PPD > 7 mm had significantly higher mean OHIP-14 scores, which means that those patients had poorer OHRQoL. This highlights the influence of periodontal disease on quality of life and suggests that the OHRQoL measure is sensitive to periodontal health. Periodontitis therapy positively affected the OHRQoL. More specifically, it has been shown that the periodontal treatment especially had a highly positive affect on the OHRQoL of patients with a PPD > 7 mm. This demonstrates that periodontal therapy improves quality of life and suggests that this measure is sensitive to periodontal therapy.

The multivariate analyses found that NA had the greatest single influence of the explaining variables; it increased the explanation percentage of the variance in OHIP-49 score by well over half of what the controlling variables accounted for combined and the parameter estimate was highly significant. The direct correlation with the OHIP-49 score was acceptable. Compared to other studies correlating NA to the OHIP score, the R-value of 0.51 found in this study is a little higher: Brennan et al. (Brennan et al., 2006) found a correlation of R = 0.36 in a large random sampled Australian population and Kressin et al. (Kressin et al., 2001) found a correlation of R = 0.46 in a large population of older men. The influence of self-esteem in this study was also significant; a large increase in the explanation percentage was found and a

significant but weak direct correlation with the OHIP-49 score was found. The greatest influence on OHIP-49 score in this study was found when both NA and selfesteem were accounted for in the multivariate model, that is, the additional variance was explained compared to when NA and self-esteem were added alone. This may be expected as the correlation between NA and self-esteem, even though significant, was low. This also makes it unlikely that collinearity problems occurred.

The maximum difference was applied to this study, and it was found that the EPI-Q score must change by roughly two units, and the RSES score must change by roughly 8 units to be clinically significant. These estimates can be used to understand the clinically meaning of the EPI-Q and the RSES. The results further showed that the reason for the clinically significant difference in EPI-Q score was related to the association between poor oral comfort and high NA; a significant difference in EPI-Q score between participants reporting poor and ok oral comfort was also seen.

In a study by Castro et al., although a positive association of periodontitis with age, male gender, smoking and educational level was confirmed, no significant association was found between psychosocial factors and periodontal disease (Castro et al., 2006). In another study by Solis et al., no evidence was found for an association between depression, hopelessness, psychiatric symptoms and established periodontitis (Solis et al., 2004).

Some mechanisms have been known to explain the relation between inflammatory process causing periodontitis and stress disorders (Muniz et al., 2015; Nagler, 2009; Pawlak et al., 2007; Pei et al., 2019; Salehi et al., 2018; Settineri et al., 2019; Ueno et al., 2012; Zhu et al., 2019). Firstly, it is hypothesized that the stress has immunostimulatory properties so that activation of the acute phase response of the immune system may be induced by repeated acute or chronic psychological stressful states which elicit the elaboration of stress hormones such as norepinephrine, epinephrine, cortisol and glucagon, together with activation of the renin-angiotensin system, sometimes in periodontitis patients (Black, 2006; Gur et al., 2021; Ju et al., 2021; Kotin et al., 2021; Tseng et al., 2021; Xu et al., 2021).

Interestingly, depressive mood states can induce hypothalamic pituitary adrenal axis hypersensitivity and the products of this system released by emotional stress may influence immune activities by immune cells via alterations in the production of cytokines (Breivik et al., 2000).

However, the present study has some limitations that needs to be addressed. One is regarding the study design; a higher number of patients as well as the prospective design may have led to

greater determination of the results of the present study. Moreover, another limitation to the study was that the OHIP-49 does not encompass all aspects of OHRQoL (de Paula Junior et al., 2009; El Sayed et al., 2019).

5. Conclusions

In the present study, NA and self-esteem were found to influence OHRQoL in the study population of partially dental patients; low self-esteem and high NA was associated with worse OHRQoL. The results evidenced that if OHRQoL measures are used to guide clinical decisions, it is thus important to determine whether the impact of tooth loss is in part a function of high NA or low self-esteem. As NA was the trait influencing OHRQoL most, poor OHRQoL may not clinically indicate worse oral health but could reflect a person's disposition to view things negatively. However, further studies with a larger sample and more longer follow-up sessions are needed to better investigate the role of periodontitis, tooth loss on OHRQoL and self-esteem (Al-Asfour et al., 2018; Al Hamad et al., 2019; Azuma et al., 2008; Castro et al., 2006; Costa et al., 2008; De Baets et al., 2012; Ding et al., 2010; Drisko, 2001).

Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any potential conflict of interest.

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